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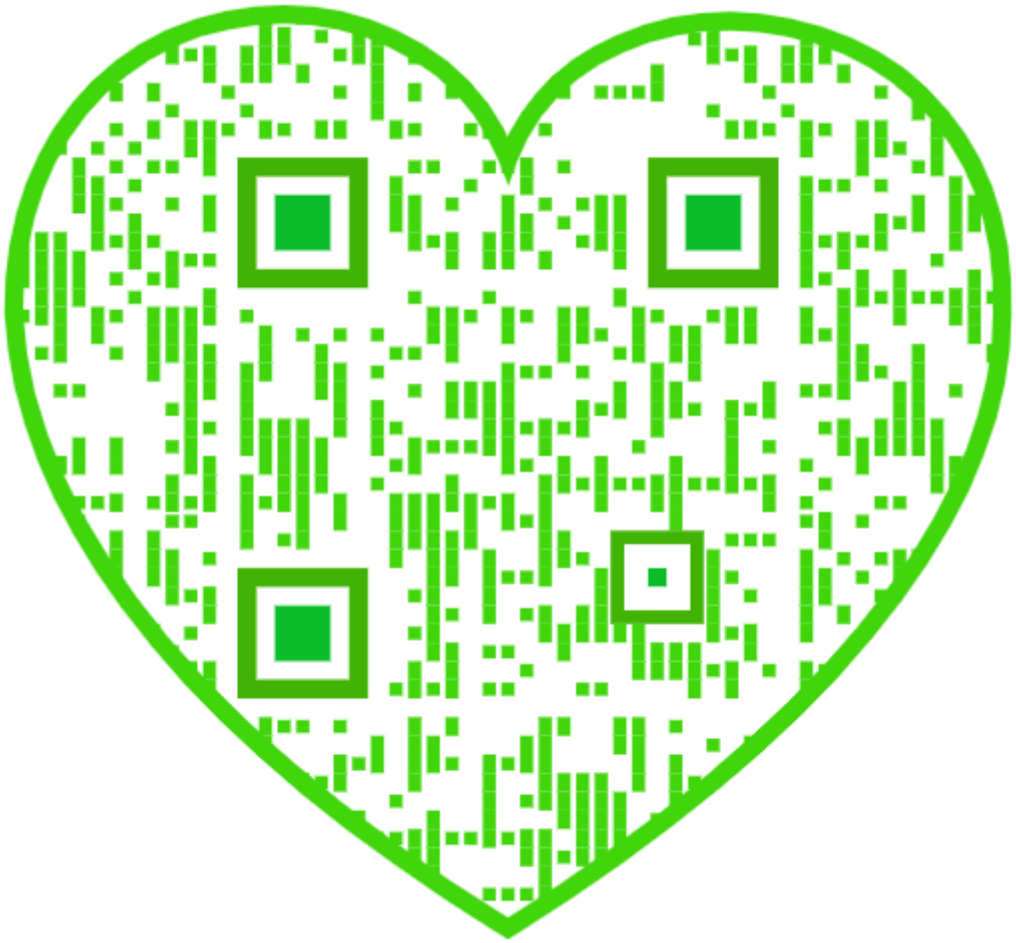

Practical photography

Frank Roy Fraprie

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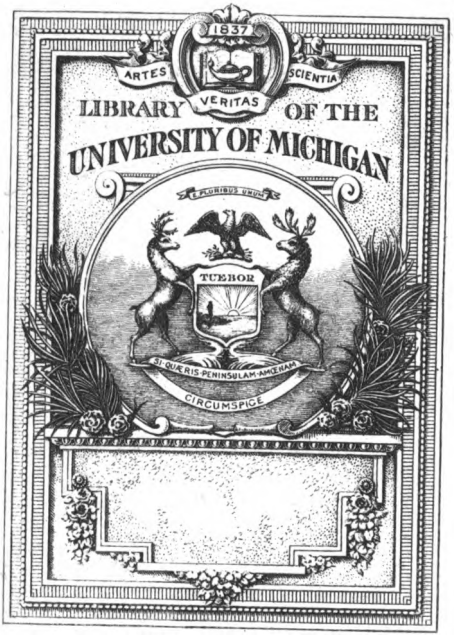

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PRACTICAL PHOTOGRAPHY, NO. 2

BEGINNERS' TROUBLES

Edited by
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Editor of American Photography

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BEGINNERS' TROUBLES.

The Why of Troubles. — The beginner in photography usually thinks it is very easy to handle a camera, and the advertisements of prominent manufacturers of photographic goods emphasize the simplicity of picture-making. So a camera is bought, loaded with a roll of film by the dealer, who explains the pressing of the button for snapshots, and the tyro sallies forth and shoots his six or ten or twelve films in blissful ignorance of the many details which must be understood to ensure perfect results. Sometimes the first roll is good, but the troubles come thick and fast later as the user begins to branch out and attempt new things for himself. This is only what should be expected, because no novice can attempt work in an entirely new field without some study. The automobilist, for instance, studies catalogs, books on the gas engine, and the maker's directions on how to run the car, and then takes lessons from a demonstrator before qualifying for a license to operate a machine on the public highway. The photographer, however, too often misled by the apparent simplicity of the camera, and full of enthusiasm, rushes ahead full tilt without stopping to learn the *A B C* of the art. This *A B C* is contained in a little book given with the camera and

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perfectly adapted to explain every point in connection with that particular model.

How to Overcome Troubles. — The best way to handle troubles is to prevent them by knowing what to do and why. This knowledge can be gained by a little careful study of the camera, following the directions of the book paragraph by paragraph and actually doing what is prescribed over and over until the manipulation becomes almost instinctive. It is best to get a dummy roll of film and practice loading and unloading, or even to waste a fresh roll if a dummy is not available. Then the details of winding a fresh film into place, locating the subject in the finder, snapping, etc., should be slowly and methodically performed until you feel perfectly confident that you can do everything properly and remember at once any omission or mistake.

Choice of Apparatus. — In photography, as in other things, the best is always the cheapest. Many troubles are due to poorly constructed, rickety cameras which leak light, get out of order easily, and otherwise hamper the novice by making his best efforts useless. It is not, however, necessary to spend a large sum of money on a first camera. The cheapest makes of reliable firms are good value for the money, and if intelligently used will produce excellent pictures. A Brownie or a Buster Brown is cheap because it is simple and inexpensive to manufacture in quantities, but it is naturally not as useful as a camera containing more expensive materials and more possibilities of manipulation. The more you pay, as a rule, the more complicated is the camera, so if you desire the greatest simplicity and the fewest things to learn at

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first, by all means get a box-form camera or one of the cheaper " fixed-focus " folding styles.

Classes of Cameras. — The box cameras have the advantage of always being ready to take a picture by simply making the snap and winding the film until the next number appears at the red window. They do not require focusing. The lenses are " single meniscus achromatic " and require good strong sunlight for successful snapshots with the single speed of snap (about $\frac{1}{25}$ second) which the shutter will give. There is, in the very cheapest forms, only one opening (usually called " stop " or " diaphragm ") in front of the lens; but the next larger size has three stops, each smaller opening requiring double the exposure of the next larger. Their use for both snapshots and time-exposures is most clearly explained in the booklet which comes with the camera.

The lowest-priced folding cameras have single lenses and shutters marked " IBT " which means " instantaneous " (or snapshot, again about $\frac{1}{25}$ second), " bulb " (the shutter remaining open as long as the release lever is pressed), and " time " (requiring one pressure to open and a second pressure to close the shutter). There are three or four stops, usually numbered 1, 2, 3, and 4, each admitting half as much light as the next larger. No. 1 is for use in all ordinary snapshots on land, No. 2 for snapshots on the water, Nos. 3 and 4 for bulb and time exposures. As before, strong sunlight is needed for successful snapshots.

Another advance in price gives us a double or rapid rectilinear lens and a shutter marked either " TBI " or " TB 25 50 100." These latter figures indicate $\frac{1}{25}$,

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$\frac{1}{50}$, and $\frac{1}{100}$ second. The lens has a relative aperture much larger than that of the single lens, and the stops are marked "4, 8, 16, 32, 64, 128." Sometimes the largest is only No. 8, but this depends on the make and the price. These numbers are the Uniform System Numbers, usually called U. S. Numbers, and indicate the relative exposures as will be explained later. Suffice it to say here that No. 8 admits twice as much light during a given snap and No. 4 four times as much light as the largest opening of the single lens, thus making it possible to take successful snapshots much earlier or later in the day as well as in the spring, fall, and winter, when the cheaper camera is useless for snaps. The shutters are automatic; that is, they set themselves ready for another snap during the closing movement.

Finally, the more expensive folding pocket cameras have not only the double lens working at a maximum stop of U. S. 4, but also a shutter provided with slow retarded exposures marked $\frac{1}{4}$, $\frac{1}{2}$, and 1 second. It is needless to say that the chances for getting correct exposure are enormously increased by the provision of these speeds, though of course one courts failure by attempting to give anything slower than $\frac{1}{25}$ with the camera held in the hand. A few steady-nerved individuals can train themselves by constant practice to hold the camera quite still for $\frac{1}{10}$ second, but most people must confine themselves to $\frac{1}{25}$ or faster.

If you buy the cheap camera and keep up your interest in photography you will wish, later on, to get one of the cameras last mentioned, or may even decide to spend more for one with a faster lens, known as an anastigmat, and a shutter with more quick

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snapshots, up to $\frac{1}{300}$ second. For all ordinary hand-camera work a No. 3 or a No. 3A, as at present equipped, will answer excellently. The addition of a light tripod to the outfit makes it possible to do all kinds of indoor and outdoor photography.

Kodaks with anastigmat lenses working at *f*:8 at a price only a little greater than is asked for the rectilinear model are worth careful consideration, as they make excellent all-around instruments and the lenses are as good as more expensive sorts when the latter are also stopped down to *f*:8. The lensmakers have also brought out these lenses in cells, ready to screw into the regular shutters, for the remarkably small price of $10 (Wollensak Optical Company). A faster anastigmat, the Vinco, working at *f*:6.8, costs only about twice as much or a little more, complete with a good automatic shutter. Other makes may easily be fitted. The advantage of the slow anastigmat is that it really covers the entire film at *f*:8 with a very perfect quality of definition right to the corners, whereas the rectilinear would have to be stopped to at least *f*:16 to get approximately the same results. The anastigmat lens should in all cases be preferred if the extra price can be spared and the purchaser is willing to use it carefully and focus with care.

Plate Cameras. — Few beginners start with a plate camera, but for the benefit of those who prefer this type to use with either plates or film-packs, it is well to add a word of caution. There are some makes which should be avoided, owing to light, flimsy construction and poor workmanship. Choose an instrument made by a firm with a reputation for using only first-class materials. Owing to the convenience of

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ground-glass focusing, it is desirable to get a camera having the following devices: reversible back (or revolving back); swing-back, preferably pivoted in the center, not at the bottom; rising, falling and cross front; rack and pinion focusing; removable lens-board. If all of these movements are operated mechanically, as they are in the better grades, it is easy to arrange the subject just as it is wanted in the picture, and the power thus conferred on the operator makes it easy to handle many classes of pictures out of the scope of the roll-film camera. For serious, advanced work the plate camera has a great advantage impossible to incorporate in the other type, with the film-pack always in reserve if desired.

The Reflex Camera. — It seems somewhat risky to mention the reflex or reflecting camera in a book for beginners, but we have seen rich novices start with such an instrument and turn out work equal to that of advanced amateurs almost from the first. The reason for this is that the possibility of seeing the full-size picture right-side up until the moment of exposure enables the user to get exactly what he wants, and the focal-plane shutter is most effective in stopping motion and at the same time giving full exposure. Either the Graflex or one of the imported makes will be found quite satisfactory for those who can afford them.

The Lens and Its Stops. — Just as a large window will let more light into a room than a small window, so the larger the aperture of the lens in relation to its focus, the shorter the exposure needed. So all lenses are provided with means for changing the size of the aperture through which light enters the camera. The

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focal-length or focus of a lens is the distance between the lens and the sensitive film when objects a hundred feet or more away are sharp and clear in the picture. The stop size is expressed by a fraction or ratio, focus divided by the diameter of the opening, as *f*:16, the effective aperture of the average cheap lens. The series of focal fractions usually adopted is as follows, the corresponding U. S. Numbers being given for comparison.

f:4	*f*:5.6	*f*:8	*f*:11	*f*:16	*f*:22	*f*:32	*f*:45
U. S. 1	U. S. 2	U. S. 4	U. S. 8	U. S. 16	U. S. 32	U. S. 64	U. S. 128

It will be seen that the two systems correspond at number 16, also that the U. S. Numbers indicate the relative exposures. Thus, if U. S. 1 requires 1 second, U. S. 2 will require 2 seconds, U. S. 32, 32 seconds, etc. The smaller numbers indicate the largest openings and require the least exposures. The speed of a lens is expressed by its largest stop according to the *f* system. A lens working at *f*:5.6 is twice as fast as one the largest stop of which is *f*:8. All lenses, no matter what their focus, are of the same speed if marked with the same stop in either of these systems; for example, a Cooke Series V at *f*:8 requires exactly the same exposure as a rapid rectilinear lens on an Ansco at U. S. 4. Most anastigmat lenses are scaled in the *f* system, but rapid rectilinear lenses supplied with cameras are marked with U. S. Numbers.

Use of the Stops. — An exposure of only $\frac{1}{25}$ second (the usual snapshot) requires a large stop in the lens in order to admit enough light to impress the picture on the film in such a limited time. U. S. 8 is the best all-around stop for snapshots in bright sunlight in the summer. U. S. 4 should be held in reserve for days

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when the light is not so good, or before 9 A.M. and after 3 P.M. U.S. 16 can be used for snapshots only when the light is very bright, as on open beaches, on the water, or in tropical and semi-tropical countries, for snow-scenes in full sunlight and other exceptional subjects. Smaller stops than U. S. 16 generally require so much time that the camera cannot be held in the hand without movement which blurs the picture; hence a firm support or a tripod is necessary. The usefulness of the hand-camera is greatly increased by the addition of a tripod, which should be used whenever possible.

The stops have another important use besides regulating the amount of light. If you take one picture with your largest stop and another of the same subject with the smallest, you will see the great increase in the sharpness of objects both nearer to and farther from the camera. Stopping down increases the depth of field, that is, it brings near and distant objects into focus at the same time. Large stops give softness, roundness, and atmospheric effect; small ones, sharpness, fine detail, and lack of atmosphere. It is a wise plan always to use the largest stop which will give the required depth. Interiors, architectural subjects, and some others, however, require smaller stops, because it is a property of lenses that they cannot focus near objects and distant objects at the same time if the near objects are relatively close to the lens. Suppose a house to be 50 feet away. If the pointer of the camera is set at 50 feet on the focusing scale, the house and everything beyond it will be sharp; but if you go up to 25 feet and set the focus at that distance the sharpness will extend only a limited distance

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towards and away from the camera. Were you to take the picture with a 15-foot focus, objects from about 10 to 30 feet would be sharp and to get everything clear you would have to stop down and give a time-exposure.

To get the best possible distribution of sharpness with scale-focusing cameras 4×5 or $3\frac{1}{4} \times 5\frac{1}{2}$ and smaller, the following table will be of use.

100-foot focus — All objects 100 feet or more away.

50-foot focus — Objects from 35 to 70 feet away.

25-foot focus — General street scenes, landscapes, etc., in which the principal object or objects are between 15 and 40 feet away.

15-foot focus — Groups, close street scenes, figure-studies, horses and wagons, etc., the principal object being large and between 12 and 20 feet away, the background containing nothing important.

12-foot focus and nearer — When the principal object is as close as twelve feet or less it is extremely important to set the focus as accurately as possible. Pace off the distance or use a telemeter.

Interiors — Measure the distance from the camera to the farthest object which is required sharp, set the focus at two-thirds this distance, stop down to U. S. 32 or 64 and give full exposure.

Care of the Lens. — The Kodak manuals give a picture showing the effect of dirt on the lens. If you make it a habit always to clean the lens just before use with Japanese lens paper you will never have any trouble. R. R. lenses should be unscrewed occasionally and all four surfaces gently wiped with a piece of the paper, never with cloth of any kind. The paper can be obtained from optical supply houses.

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The Shutter. — The makers' instructions for the single-speed shutters on the cheaper cameras are so clear that we must refer the reader to his instruction booklet. We have space here only for some warnings which will prevent shutter troubles. Never meddle with the shutter or try to oil it. If it gets out of order take it to your dealer for repairs and he will, if necessary, send it to the makers. When you get a new camera, study the section of the booklet which describes the shutter, identify every part, and practice setting it for all the different speeds. Make sure that you understand the markings for the stops and have placed the indicator at the proper stop number for the speed the shutter is set for. To illustrate, we have found that many failures result from making snapshots when the indicator has accidentally been pushed to U. S. 16 or smaller, and U. S. 8 or even 4 is needed. Always make it a point to look, just before exposing, at the indicators to be certain that they are correctly placed, not at bulb or time when a snap is wanted, nor at 32 when 8 is desired. The sure way to avoid trouble is to write out a table similar to the following and practice it until you perform all operations without fail:

1. Immediately after every exposure wind a new section of film into position.
2. Estimate distance and set the front at correct focus.
3. Verify speed of shutter.
4. Verify stop in place in the lens.
5. Level the camera.
6. Locate the image in the finder just as you wish it to be.

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7. Take a breath and hold it.

8. Immediately press the release-lever or the bulb.

Releasing the Shutter. — It takes time for some people to learn the right way to snap a shutter without moving the camera. The camera should be held firmly but lightly in both hands and away from the body. The thumb should rest lightly on the release and the fingers of the right hand should be so placed under the instrument that the motion of pressing is in the nature of pinching the fingers and thumb together rather than punching with the thumb. Thus the tendency to push the camera down is counteracted by the upward pull of the fingers. A little regular practice will perfect you in releasing the shutter properly without the expenditure of a single film, for you should drill yourself regularly at first with the empty camera. It is better not to use the bulb and tube for hand camera work, though it is most useful when the camera is placed on a tripod.

Loading with Films. — The following points, which are not mentioned in the booklets, may be of assistance. Remember that if the paper loosens sufficiently to admit light between the flanges of the spool and the paper, the edges of the film will be light-struck and will turn black when developed. The stronger the light the worse the defect; therefore, *always* change film in as subdued a light as possible. Place the roll in the camera and secure the pins in the holes before breaking the seal. Be sure that the paper does not loosen much while you are threading the paper into the slot of the receiving-spool — the one which has the key. In unloading the exposed roll, take similar precautions to keep the paper snug on

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the spool, but do not wind it up tight or the film will be marked. If the paper has been adjusted to feed true from one spool to the other the joint will be good without the tight winding. Simply get the paper snug and seal the end with the gummed label while holding it firmly enough to prevent unrolling. The manuals should be most closely followed, not neglecting drill with a dummy cartridge.

Loading with Plates. — Plates are packed in pairs, face to face; therefore, when the box is opened the top plate has the uncoated side upwards. Turn this side to the ruby light and see how it reflects the light. Then do the same with the other side and notice how little it reflects and how dull and yellow it looks. This gives you a test to guide you so that each plate will be put into the holder with the dull side out, that is, toward the lens when the holder is in the camera. Handle the plates entirely by the edges so that the finger-tips never come in contact with either side. The holders should be prepared before the plate box is opened by removing the slides, dusting holders and slides with a wide, rubber-set camel's hair brush, and stacking them neatly with a pair of slides under each empty holder, and the white side of the wooden head of the slide up, to avoid having to look to see if it is in correctly. It is well to get a dozen spoiled plates and practice loading and unloading until you can do it by touch in the dark, this plan ensuring you against fog from too much exposure to the not-always-safe ruby light. If you learn a correct method and follow it habitually you will be free from all troubles which are preventable. Remember that all odd-numbered plates are face down and all even-numbered plates

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face up in the original packing. Endorse on the box the number removed, as follows: — 6 out, March 24, 1915.

Dusting the Plates. — A good way to remove dust from plates is to hold the plate face down and brush it very gently with the wide, clean, camel's hair brush so that the dust falls away from it. This is best done after the plate is in the holder. But as the brush sometimes electrifies the plate and causes it to attract dust, it is better to hold it by the edges near the top in a slanting position, film down, and give it one smart rap on the table. The same operation repeated before development will ensure freedom from pin-holes due to dust.

Filmpacks. — The pack once inserted into the camera or the adapter, as the case may be, great care must be used to draw the paper tabs out slowly and gently. Almost all troubles with packs are due to careless, violent manipulation, pulling the tab out crooked, thus jamming and crinkling the edges. Former troubles due to scratches and crescent-shaped markings should not be in evidence, as the films are now coated with plain gelatine over the emulsion to prevent these defects. It must be noted, however, that the film does not always lie perfectly flat, particularly in the larger sizes, and the defective definition which ensues is more noticeable with high-class lenses than with cheap ones. As a general thing, packs larger than $3\frac{1}{4} \times 5\frac{1}{2}$ or 4×5 are not suitable for use with anastigmat lenses. The improved style of pack introduced by the Ansco Company in 1915 has only one tab projecting at a time, obviating the possibility of pulling the wrong tab.

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Handling the Camera. — The box style of camera is so simple that few precautions need be noted. The most important are to hold the camera steady and perfectly level and to press the release without jerking. To regulate the amount of sky and foreground with cameras which have no rising and falling front, it is necessary to hold the instrument at a greater height to reduce the amount of foreground, never departing from the rule to hold it level.

The Rising Front. — No folding camera will close easily unless the front is set to bring the lens exactly opposite the center of the film, so be sure always to adjust it thus after you are through with the rising, falling, and cross movement of the front. These adjustments are used mainly with the camera on a tripod, but experience will teach you how much rise or fall to use for a given variation of foreground. As in the case of the simpler boxes, the camera must always be held level, except in the case of the plate-camera with swing-back.

The Swing-Back. — The swing-back provides a means to set the plates perpendicularly when the camera is tilted, because it is a law of optics that perpendicular lines in the subject appear perpendicular in the picture only when the surface receiving the image is strictly vertical. Focusing on the ground-glass, if the whole of the subject cannot be included when the camera is level by using the rising and falling front, the instrument may be pointed up or down and the swing used to bring the plate vertical. A medium stop is usually needed. Another use of the swing-back is to focus foreground and distance at once in landscape work. If the camera is not tilted,

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the swing may be moved to carry the top of the plate farther from the lens so that the image of the foreground comes into focus on the plate, even with a large stop. Personally, we would not be without a camera with a swing-back, so great are the advantages of this useful device in all kinds of work. This indicates one superiority of a plate-camera, even if used with filmpacks, over the more limited roll-film camera.

Defects in Film-Cameras. — Owing to the fact that a section of film is always in position ready to be exposed, certain accidents may occur with roll-film cameras. Round spots of great density in the middle of the film may be due to several causes. Sometimes in closing the camera, after the front is pushed home the bulb is accidentally pressed, operating the shutter. Sometimes the indicator gets moved to time and the shutter is left wide open. A leaky shutter, even if closed, may give the round or crescent-shaped white spot, or, if the bellows is extended, a general blackening of the film. Pinholes in the bellows may give images on the film or a general light-fog. The metal backs of folding pocket cameras sometimes get bent or warped and allow light to leak in and fog the edges of the strip of film. Leaving the camera in bright light is another fruitful source of defects. It should be kept protected as much as possible except at moments of use. Sometimes the aluminum rollers over which the film is fed do not revolve readily and thus scratch the film as it is pulled over them. The remedy is to apply a tiny drop of oil to the bearing, and have the rollers carefully smoothed with the finest grade of emery cloth. Cameras made with-

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out rollers may require the fitting of strips of velvet to prevent the film from being scratched on the frame where rollers should have been provided.

Troubles with Plate-Cameras. — Some of the troubles mentioned above cannot occur with plate-cameras, but there are others peculiar to them. With either kind the front may be ruined by trying to close the camera when the adjustments are off center, the finder is out of place, or the pinion-head pulled out. The great danger with plates is the risk of fogging them by not seating the holder so that its groove or tongue, as the case may be, completely excludes light. Holders should be carefully fitted to the camera so that they lie closely in place. The slide must be drawn straight out and reinserted straight or light may leak through the opening and fog the plate. It is a good plan to draw the slide under the focusing-cloth and to drape the latter over the back of the camera until the slide has been pushed home. Leaky valves in the head of the holder are not so frequently found of late years; but once in a while the most modern designs of flexible valve stick, and then the holder must be rejected or sent to the factory for repairs.

Locking the Front. — Folding cameras of the fixed-focus type must have their fronts pulled out to the limit of motion to ensure the sharp focusing of the picture. Those with focusing-scales must be carefully set before use. Most kodaks are provided with a lock which is set for the desired distance before the front is pulled out, the lens then coming to the right position and locking there as soon as pressure on the finger-clip is released. Wear may cause the locking-

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device to loosen, so it is most important to test the adjustment and make sure the front is rigidly held at the proper focus. Do not neglect to verify the focus before every picture. Plate-cameras often have a hook which must be turned to lock the front, so be sure it is firmly set and the pointer is exactly over the proper figure. Look at the pointer and scale with the eye perpendicularly above them, and remember that the finer the lens the more exactly it must be focused. This is one reason why we do not recommend fast anastigmat lenses for the beginner except on reflecting cameras or plate-cameras.

Preparing the Film for Tank Development. — In the case of some makes of films it is absolutely essential to stick the free end of the film to the backing-paper before transferring it to the spool and apron for tank-development. Pay particular attention to this point if you do not wish to ruin your roll.

Cleanliness. — Fully half the troubles of the beginner are caused by dirt, which has been defined as matter in the wrong place. Plates, films, and papers are peculiarly sensitive to dust, impurities in water and other chemicals, and also to the right chemicals at the wrong time. The booklets issued by manufacturers treat so fully of the defects caused by dust that we prefer to refer the reader to them, mentioning particularly the Cramer Manual and the Imperial booklets as among the best. The workroom must be kept scrupulously clean and frequently dusted with a moist cloth. The floor should be done with a wet mop. Above all, do not let hypo drip anywhere without washing it up immediately. Never let the least trace of hypo remain on the fingers, but wash them

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well under the faucet and dry them at once on a towel kept for that purpose only. Renew the towel at frequent intervals. The developer must be kept absolutely free from contamination with hypo. Rinse all utensils with clear water both before and after use. Keep a separate tray for each chemical. Wet salt is one of the best cleansers; but obstinate stains may be removed by soaking the dish in potassium permanganate acidified with sulphuric acid. White porcelain or white enamelled trays are the easiest to keep clean, because dirt shows at once on the surface.

Solid particles in developers may be guarded against by filtering through absorbent cotton in a filter-funnel immediately before use. Another cheap filtering dodge is available. Get a wire-mesh strainer at the 5- and 10-cent store and cover it with several thicknesses of fine muslin. We once knew a professional who never had a pinhole on his negatives, and he attributed his freedom from them to his habit of invariably filtering his pyro developer through this kind of strainer just before use. He rinsed it under the tap and kept it hanging over the sink when not in use. Dirt in the hypo may be easily removed by placing the crystals in the middle of several thicknesses of cheesecloth, folding up the ends and tying them and then suspending the bag thus formed in the mouth of a large jar of water so that it hangs just below the surface. Not only is the dirt separated, but the chemical dissolves more quickly without attention.

Exposure. — The hardest part of photography to learn is how to give the right exposure every time. We have already pointed out the fact that snapshots

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cannot be successfully made with single lenses in $\frac{1}{25}$ second except between 9 A.M. and 3 P.M. in bright sunlight during the summer months. Probably more beginners give up photography in disgust because they attempt the impossible with these cameras than because of any other one thing. And yet if they were to use a tripod and give bulb or time exposures with the smaller stops, they would be encouraged to continue by the excellence of their results. The only thing needed is a reliable guide, and this is furnished in convenient pocket form by the *American Photography Exposure* Tables, based on many years' practical experience and extremely simple in practical working.

The Exposure Tables. — The elements needed to estimate the correct exposure in any circumstance are five, the speed or sensitiveness of the film or plate used, the chemical or actinic strength of the light, the stop used in the lens, the character of the subject, and the month and hour. These tables assign an arbitrary number to each of these elements and tabulate them in a form convenient for reference. The sum of the numbers is taken and looked up in a final table, and opposite this sum is printed the necessary exposure in seconds, minutes, or hours, as the case may be. The accuracy of the system is great, particularly as all the plates and films on the American market were scientifically tested for speed before the present edition was printed. The tables are so easy to understand that we hope every reader will get one or No. 1 of this series and follow its teachings closely, in which case the bugaboo of exposure-difficulties will disappear at once and forever. A few remarks to aid the novice in its use will, nevertheless, not be amiss.

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Subject. — We sometimes have inquiries from readers of *American Photography* about subjects not distinctly specified in the tables, so it may be well to explain the classification adopted.

"Sea (only) and clouds" is the first one, with a value of $\frac{1}{2}$. This means a picture taken on the open sea, or a large lake with no objects within a mile, the operator being on the shore or in a boat.

"Sea views, snow scenes, distant landscapes" come next, with a value of 1, which indicates at once that these subjects require double the exposure of the $\frac{1}{2}$ class. Pictures with ships, yachts, and boats as the principal objects, general snow scenes with no important dark objects near the camera, and landscapes of an open or panoramic nature, as in mountain valleys, from the crest of a hill, or others in which there is no foreground, are included.

"Open landscape with unimportant foreground," value 2, includes all landscapes in which the distance is not the chief interest in the picture, but in which no important part nearer than about 50 or 100 feet is included, such as views in open fields, on the shores of the sea or of lakes, snow scenes with trees and other dark objects, ships and yachts rather near with water foreground, houses in the distance, and other similar subjects.

"Average landscape with foreground," value 3, is a large class. The foreground may be of average color, such as grass, or pavements, or bare earth, but should not contain the principal object, which latter should be about 25 feet or more distant from the lens. There should be no large, dark-colored objects nor heavy masses of shadow in the near foreground for

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a view to come in this division. Open streets and roads, as in country towns, fields, light-colored buildings and monuments, animals, people, etc., at the distance named above, boats and figures in the foreground on an open beach, and ships and yachts close to the camera are some of the variations. To these we should add snow scenes when there are dark objects rather near the camera.

"Landscapes with heavy foreground," value 4. This value is to be used when an average landscape has its foreground in heavy shadow or composed of objects of dark, inactinic colors.

"Street scenes, buildings, groups," value 5. The street scenes here meant are those in city streets where tall buildings cut off the light to a great extent. If there is a heavy shadow in the foreground such a street might need to be classed as 7. By buildings is meant a picture of the nature of an architectural study, the image of the house practically filling the picture-space and requiring full rendering of detail in the shadows. Groups of three or more people are usually posed near the camera to get the figures reasonably large and hence they require more time, because it is a law of light-action that the less air there is between the lens and the object, the more exposure is required. This applies to groups in the shade. If the group is posed in sunlight it should be classed as average landscape.

"Portraits in shade," value 7. Half-length figures near the camera and head and shoulder portraits in the shade outdoors are included in this class. To it we may add landscapes with very near, dark foregrounds, heavy masses of shadow, or large, dark-

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colored objects; also objects distant less than fifteen times the focal-length of the lens and pictures taken well under the shade of trees and not open to the sky.

"Indoor portraits," value 8 to 10. The smaller value should be used for full-length or for bust portraits in a brilliantly lighted room with the subject near a large window. The greater, or even higher, should be chosen for darker rooms and large head and shoulder pictures. In portraiture it is most important to time very fully to counteract the effects of concentrated illumination and the resultant heavy shadows.

"Interiors," value 8 to 16, need no explanation, as these factors apply to average rooms, and the best factor for a given room can be found only by trial.

The "Golden Rule" of Exposure. — An old and well-tried principle is to time the exposure for the shadows, particularly those near the camera, and to take care of the highlights in development. This should be kept always in mind, together with the saying that clear glass anywhere in the negative is a sign of underexposure, and subjects should be graded accordingly in using the exposure tables.

Light. — "Intense sunlight" is characterized by the fact that objects throw an inky-black shadow. The sky is usually cloudless.

"Bright" means sunlight, but the sky is generally full of clouds, which reflect light in all directions and throw a great deal into the shadows, which, though well-marked, are softer and less intense than when the light is not diffused.

"Faint shadow cast by sun" applies to all atmospheric conditions when the light is so diffused

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that the shadows are weak and, indeed, barely perceptible.

"Dull" is generally understood to mean that no direct shadows are cast by objects, though the light may still seem very bright to the eye. In summer, with the sky full of large, fleecy clouds, the light may be bright one instant and dull the next, owing to cloud-shadows, so it is necessary to watch for precisely the right moment to expose.

"Very dull" is the light which occurs in rainy weather when the whole sky is obscured by dark, heavy clouds. A few comparative exposures on a showery day will teach you more than a volume of directions about the strength of the light in these circumstances.

Plate-Speeds. — The classification of plates in the tables is based on actual H. and D. tests of the plates, but there may be slight variations from time to time as different batches of plates come into your hands, because it is quite impossible to make all emulsions absolutely identical. If you get overexposure and feel very sure that you have correctly estimated all the other values, it may be necessary to try another number, and vice versa for underexposure; but the speeds as listed represent with fair accuracy the average speed of the brands.

Snapshots. — A snapshot is understood to mean an exposure of $\frac{1}{25}$ second or less. The exposure table will tell you whether a snap will be sufficient exposure for the subject in hand. If it is not, use a firm support, such as a stone, fence, table, or anything solid, with a smaller stop, as indicated by the tables. Remember that $\frac{1}{25}$ second is too slow to stop motion and do not

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attempt moving objects unless you have a fast shutter or a reflex camera.

Bulb Exposures. — With the shutter set at "bulb," exposures of about $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{3}$, or $\frac{1}{2}$ second can easily be given after a little practice. As a general rule, pressure and immediate release of the rubber bulb or flexible release will give nearly $\frac{1}{8}$ second.

Time-Exposures. — For exposure longer than a few seconds it is best to set the shutter for "time." Practice counting seconds in time with the second hand of your watch, saying "One and one, two and two, three and three," etc. Most people count half seconds. A convenient half-second pendulum can be made by fastening a bullet to a string just short of ten inches. Seconds are counted at one end of the swing, thus: swing and return, 1; swing and return, 2, and so on.

Shutter Speeds. — Most shutters are inaccurately marked and vary in speed to so great an extent as sometimes to upset one's calculations. The speed marked $\frac{1}{100}$ is seldom shorter than $\frac{1}{50}$; the $\frac{1}{50}$ is often more accurate; the $\frac{1}{25}$ may be faster or slower than supposed; and the retarded speeds, $\frac{1}{5}$, $\frac{1}{2}$, and 1, are seldom anywhere near the marked values. If you wish to be sure, test your shutter at the beginning of each season's work, and at intervals during the season if possible. With most makes of shutters, it will also be found that when the camera is turned so that the shutter is no longer upright, the exposures, at the same setting, are different. There are some shutters, particularly the more expensive models, which are less subject to these defects. A most excellent device, the Wynne Shutter-Speed Tester, costs only

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$1.75 and is highly recommended for speeds up to $\frac{1}{100}$ second.

Development. — Next to troubles in exposure in the beginner's list come those in development. It is a most excellent plan to have one's film development done by a reliable photo-finisher at first, because one can then put all one's energy into mastering exposure and learn from the negatives and the prints which they yield what is good and what is bad. Later, if interest in photography continues unabated, the mysteries of development may be investigated. But there are many who wish to do it all from the first, and they find themselves swamped in a sea of troubles. Taking up first the development of films by hand, we will now consider the troubles which may occur, their causes, and how to prevent them.

Light-struck Films. — The novice usually buys a cheap ruby lamp and works too close to it. As most modern roll-films and filmpacks are extremely sensitive to all but deep red lights, the result is dull, foggy, veiled films. From one to seven dollars is not too much to pay for a good ruby lamp, the particular style chosen depending on one's conveniences in the way of light, whether oil, gas, or electricity. The old Carbutt style of lantern is one of the best, though on hygienic grounds it is wiser to have the light outside of the developing room. Whatever style is chosen, insist on at least one sheet of copper-flashed ruby glass and one of orange glass. Test the safety of the light by putting a piece of unexposed film near it for five minutes and developing it in darkness. If it shows fog, the light must be dimmed by adding ruby and orange tissue or paper until a further test proves its

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safety. In any case, expose the film as little as possible to the light and work several feet from it if possible.

Defects in Films Developed by Hand. — Developer too warm, say over 70° Fahr., too much handling with warm fingers, failure to keep the film under the developer all the time, nicks with the finger-nails or against the tray, all cause defects in the finished negative. Heat will cause the gelatine coating of the film to run. Stains and uneven density result from uneven immersion. Holes of all sizes come from rough handling. If film is developed in the strip, the following precautions will be needed. Buy suitable metal film clips with which to hold the ends of the strip. Place the tray of developer, which should be about three-quarters of an inch deep in the tray, in a larger tray containing lumps of ice. Use your thermometer, and get the developer to 65° or even 60° before beginning to develop. Wet the film thoroughly by passing it through clean water before placing it in the developer. Keep the strip in constant motion until the process is completed, that is, until the image begins to show dark on the back of the strip. Then pass the film several times through a deep tray filled with clean cold water and transfer it to the fixing-bath.

Fixing Film in the Strip. — The best way to fix film in the strip is to have a wooden tray made and lined with oilcloth. Have it long enough and wide enough to take the whole strip and fill it to a depth of an inch with acid fixing-bath. Keep the film submerged all the time by placing strips of heavy hardwood on it and leave it there at least twice as long as it takes to remove all the milky appearance, moving the wooden strips from time to time. Should your energy hold

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out there is of course no objection to fixing the film by keeping it in constant motion just as in developing.

Washing Film. — Washing in the strip may conveniently be done in the following ways. One plan is to pin the film to a board and float the whole, film down, in about a foot of water in the bathtub, changing the water four times at intervals of fifteen minutes. A quicker way is to tack strips of wood along the edges of the board to keep the water from flowing off and to hang one end to the faucet. The stream can be regulated so as to cover the film completely, when fifteen minutes' washing of each side is sufficient to eliminate all the hypo.

We most emphatically do not advise cutting up the film until it is dried, because the sharp edges and corners are almost sure to injure the wet film and cause holes, scratches, and other defects.

Drying Films. — After the film is thoroughly washed, the superfluous moisture must be removed. A film-squeegee is best, but with care a satisfactory job can be done by drawing the strip between the fingers. Take great pains, in the latter case, not to gouge pieces out with the nails. Fix a metal film-clip to each end and hang the strip from a shelf in a current of air in as dust-free a place as can be found. Avoid temperatures under 60° or over 75°, if it is possible, because quick, even drying is essential. Too much heat will cause the films to dry too dense, or, if extreme, may melt the gelatine. Never let sunlight fall on them while drying.

Tank-Development of Films. — Few amateurs nowadays use anything but the film-tank for developing their exposures, on account of the convenience, ease

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of operation, and freedom from fog, stains, holes in the film and other defects. The tank undoubtedly yields the greatest proportion of good negatives of any method, because the weak developer acting for twenty minutes brings out all there is in an under-exposure, does not carry correctly-timed films too far, and also does not remove over-exposures too soon. The volume of developer being large, it does not change temperature greatly during twenty minutes, nor does it absorb much air. Furthermore, the film is perfectly protected from light and comes out cleaner and crisper than is the case when developed in a dark-room by ordinary ruby light.

There are, however, some troubles which afflict the user of the tank. The first, and probably the most distressing of all, is the total loss of the roll because the operator has forgotten to stick down the free end of the film before transferring the film to the light-proof apron. This omission results in the rolling up of the film into a sticky, streaky tangle quite beyond hope of repair. Careful, methodical following of the directions which come with the tank is the only remedy.

Air in the water is a cause of streaks, bubbles, and weird markings. The user of the tank should provide a large bottle, fill it with boiled water, and cork it tightly. Thus, after standing, a supply of practically air-free water at the natural temperature of the room is assured. The boiling, besides removing the air, purifies the water from some injurious chemicals, and if the developer be filtered into the solution-cup through a tuft of cotton, an astonishingly large number of troubles will be automatically prevented.

Failure to follow the direction to move the roll

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slowly up and down a number of times before closing the tank is another cause of air-markings. It is quite necessary to perform this operation in order to expel all air confined in the roll and thus allow the developer to act evenly from the start over the entire surface of the film. The regular turning of the tank end for end every three or four minutes is another necessary precaution to prevent uneven development.

The thermometer is indispensable in tank work. If the film is immersed in a solution over 70°, the backing-paper will almost always stick firmly to the gelatine-coated back of the film. Solutions cooler than 60° needlessly prolong the time of development. Whatever the temperature, a careful reading of the thermometer should be taken after the developer has stood in the cup for about a minute, and the duration of development should be varied to suit. The Eastman table prescribes one minute less for every degree over 65° and one minute more for every degree less than 65°. As it is practically impossible to secure and maintain a uniform temperature of 65°, too great attention cannot be paid to this point. It is well, however, to get as near to it as possible when obliged to work in a room colder or hotter than the normal. Setting the tank in a pail of water at the right temperature for some minutes before beginning work is the easiest way, and the temperature should be observed repeatedly until it remains stationary.

Varying the Time. — For negatives intended for enlargement and for printing on the contrast grades of gaslight papers, it is advisable to develop for less than the full tank time with the regular pyro powders. Fifteen to eighteen minutes at 65° will generally be

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enough. The advantage is that the highlights do not become "plugged." Even weak pyro has a tendency to give negatives which look pretty, but which fail to print out the fine gradations in the highlights and halftones before the shadows become too black. Reducing the time of development from the standard 20 to about 17 minutes will prevent the filling up of the halftones in the lights and thus preserve finer gradations. This is particularly desirable if the negatives are intended for enlarging, and they will be found excellent for contact printing on the contrast grade of gaslight paper.

The Watkins Time-Thermometer. — A simple, reliable, and scientific method of determining the right length of time to develop is provided in the time-thermometer of Alfred Watkins. In this instrument there are no temperature-markings, but only minutes to develop. It is adjusted for the regular pyro tank-powders, but may also be used with a number of other developers, such as M.-Q., rodinal, azol, and others. Having brought the developer in the tank to the temperature of the room, preferably by the use of boiled water which has been standing there for some time, one immerses the thermometer and reads the time to develop against the mercury. Variations for different brands of films are made by altering the dilution of the developer. All makes of plates and films are listed on the speed-card supplied with the thermometer and divided into groups according to the speed at which they develop, as follows:

Ansco Film	S
Rexo Film	S
Barnet Roll-Film	VS

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Ensign Film	MS
Graflex Film	VS
Kodak Speed Film	VS
Lumiere Film	S
Premo Speedpack	VS
Vulcan Film	S
Wellington Film	MS

Modified Thermo Metol-Quinol. — The developer recommended is made by the following formula:

A.	Potassium metabisulphite	60 grains
	Metol	30 grains
	Hydrochinon	90 grains
	Water to make	20 ounces
B.	Sodium sulphite, anhydrous (1 ounce av.)	440 grains
	Sodium carbonate, anhydrous (1½ ounces av.)	660 grains
	Water to make	20 ounces

It is used as follows: for each 10 ounces of tank-developer required, take of each solution the number of drams indicated under the code-letter for development-speed of plates. For convenience we give the complete list, as the method applies equally well to all brands of plates with any make of tank.

VVQ	VQ	Q	MQ	M	MS	S	VS
1½	2	2⅔	3½	4½	6	8	10

The advantages of this method are that the novice is not required to inspect the plate or film and attempt to judge how far to carry development. As a usual thing, this is the hardest point about development, even for the experienced worker. The Watkins method has been adjusted by most careful experiments so that when the directions are strictly followed the developer gives a fixed amount of contrast between the tones from highest lights to deepest shadow. It is scientifically correct to develop exposures of all

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degrees of accuracy for a fixed time, because it has been established beyond doubt that it is not the function of development to regulate anything but the contrast between the tones. It goes without saying that the more precise the exposure the better the result, but it is true that nothing is gained by developing underexposures for longer than the standard time. The effect of such a procedure is seen in practically all beginners' self-developed negatives, for they have a tendency to continue development in the vain hope of bringing out more shadow detail. The method is also correct for overexposures, which novices usually underdevelop. A further advantage is that as the plate should not be inspected, the tray may be covered with a light-tight cover and rocked occasionally until the time is up. The light is then put out, the plate rinsed, placed in the fixing-tank and covered, and another plate started in darkness before turning on the light again. Using this method, and entirely disregarding all other systems, the beginner may be sure that he has secured all that his exposures are capable of yielding, so if he finds his negatives lacking in any particular he may rely on it that his only remedy is to use more care in exposing.

Prolonged and careful tests have convinced us that the Watkins Thermo method is the best to recommend to beginners, as it automatically ensures correct development. If the negatives are correctly timed but prove too thin or too dense for the paper you use, and on trial with other papers you cannot get satisfactory prints, all that is needed is to adjust the printing-quality of the negative by using the developer one class more diluted for less contrast or one class more

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concentrated for more contrast, without varying the time called for by the thermometer.

The Thermo Card. — The Watkins method has recently been adapted for use with an ordinary thermometer, and a table of times to develop is given on the Thermo Card, price 25 cents postpaid. This card gives formulas for four different developers, a complete list of development-speeds of plates, and all other necessary information. The Card can be ordered from our publishers or your dealer.

Defects in Plates. — The platemakers' manuals give a complete list of defects and their causes and should be most carefully studied. As prevention is better than cure, it will not be out of place to indicate a correct method of tray development. Use only fresh, active chemicals which are chemically pure. Prepare the solutions carefully and filter them just before use into perfectly clean measures. Place the exposed plate face up in the tray and holding it carefully in the left hand pick up the graduate full of developer with the right. Use sufficient developer to cover the plate well, say 1½ to 3 ounces for a 4 × 5 plate in a tray of the same size; other sizes in proportion. Tilt the tray so that the nearer right-hand corner is lowest, place the edge (not the lip) of the graduate at that corner and pour the solution with one even sweep over the plate. As you begin to pour, carry the graduate away from the body and at the same time tilt the tray away from you so that the developer will flow evenly and rapidly across the plate. If well done (and it is easier to do than to describe), there will be no trouble from streaks, spots, air-bubbles, and other blemishes. As soon as all the solu-

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tion is in the tray, set down the graduate and rock the tray a few times. Then cover it and note the time required to complete development. An occasional tilting of the tray is all that is needed to prevent mottling. Plates thus developed are as clean and brilliant as if done in a tank.

The Watkins Time-Developer. — For those who do not care to purchase a time-thermometer, practically the same method is available in the form of a prepared developer in either liquid or powder form, with a thermo-indicator which allows for variation of temperature. The choice is simply a matter of convenience.

The Watkins Factorial System. — Another popular method devised by Mr. Watkins is a factorial plan of development, but it is open to some objections. It requires watching of the plate for the appearance of the first sign of the image, and it is during the early stage of development that the film is most sensitive to light and most easily fogged. The time in seconds of the first darkening of the plate is observed and multiplied by the factor found right by experiment for the particular developer in use and the answer is the time required for complete development. The contrast can be regulated to suit the user, taking a lower factor for less and a higher factor for more contrast. If tray-development of plates by inspection is practiced, the beginner should use the factorial method until he has learned exactly what type of negative is best suited to his needs. Then, if he wishes, he can inspect the plate in front of the red light when the factorial time has elapsed and judge exactly how far to regulate the final result by looking

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at the plate, but it takes a great deal of experience to learn just when to take the plate out, so we cannot too strongly urge the adoption of one of the methods described above.

Development of Special Subjects. — Portraits, interiors, and subjects presenting great contrasts or harsh lighting, sometimes need special treatment. In the Watkins Thermo systems, this is readily given by using the developer one class weaker than the standard for the same duration of development or treating the plate in use as if it were one class faster in developing-speed and shortening the time. The method with the time-thermometer excels because it automatically provides a weaker developer for the plates which tend to produce great harshness if developed with too strong a solution. On the other hand, the slow-developing plates and films need a concentrated developer and get it. Should greater contrast than normal be desired, it is easy to strengthen the developer or to increase the time, but practically the only subjects demanding abnormal contrast are copies of black and white line drawings. One test quickly determines whether your negatives print just as you wish them to, and after you have found the correct dilution for the plate or film in use the system automatically gives you a standard contrast every time, thus leaving you free to put all your thought on exposing exactly right.

Tentative Development. — Formerly the beginner was guided only by vague descriptions, such as "Develop until the highlights come through to the back," or "Development should be carried much farther than appears necessary, as the image goes back in fixing."

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It takes considerable experience to form a correct estimate by inspection alone, particularly if the beginner keeps changing from one developer to another. There is no advice more often given and less often heeded than to select one formula and stick to it. Any good developer will produce splendid results if the following points are heeded. First, use the solution with enough water to bring out the image slowly, so that it will be soft in the early stages of development. A diluted developer always gives better gradation in halftones and highlights than does a strong one, and sufficient contrast can be had by continuing the process to the right point. Second, do not exceed the amount of carbonate called for by the formula. Third, make up the formula without bromide, but keep some ten per cent solution on hand to add if the plates prove foggy, or add more sodium sulphite.

In using a new formula for development by inspection, time the process by the factorial system and fix. Judge the negative wholly by the print. If the print is too contrasty, use a shorter factor; if too flat, a longer. Repeat the trial until the factor which suits you best is found, then determine just how the plate looks both when held up in front of the ruby light and when examined from the back. This gives you an exact mental image of the way future plates should look when you rely on inspection alone. But in all cases, remember that exposure decides the rendering of the separate tones or secures a difference in light-action for the various gradations. And remember, too, that the result should be judged by the print, for the negative is merely a means to that end; and that

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if you use the exposure-tables your exposures will be about right, and will require no juggling with the developer beyond finding the right dilution to suit the emulsion in use. Another test is to place a finger behind the plate and compare its shadow with the principal highlight. When the latter looks as black as the former, fix.

Fixing. — There are many troubles in fixing, but most of them are avoided at the start by buying the acid fixing-powders sold for films and papers. The common formula for gaslight papers is a different proposition when you try to mix it for yourself. In the first place, the sodium sulphite must be pure and fresh, for if it has partly oxidized to sulphate it fails to prevent decomposition of the hypo by the acetic acid. Next, you must secure the No. 8 acetic acid called for by the formula. If any other strength is used there will be trouble unless the following plan is adopted. Dissolve the hypo completely in the stated amount of warm water. Weigh out the alum and the sulphite and add them to water of the *B* solution. They will not dissolve, but will form a heavy white precipitate. Now add acetic acid, while stirring well, until the precipitate just dissolves. If the acid hardener thus prepared is added to the hypo solution slowly while stirring the latter well and precipitation of the sulphur occurs, it is proof positive that the chemicals are impure and they should be thrown away and fresh purchased. The anhydrous sulphite is best.

Plain Hypo. — The beginner is often advised to dissolve only just enough hypo at the time of use and to throw it away afterwards. From this plan we dissent. Unless the bath is made up fresh and used

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cold it does not harden the film sufficiently to prevent frilling. If it is used cold it often blisters or frills the film, particularly in hot weather, when other solutions are warm. It is much better to use an acid bath in a large grooved fixing-box.

Simple Acid Fixing-Bath. — If an acid bath is provided in a tank it will always be at the same temperature as the room and thus prevent all the troubles due to change of temperature. One of the best formulas is:

Hypo	16 ounces
Water	64 ounces

Dissolve and add

Potassium metabisulphite	1 ounce
Water	16 ounces

This solution may be used until its action becomes slow, when it should be rejected and a new one mixed. Another fine acid preservative and hardener is sodium bisulphite, which comes in both powder and liquid forms, the latter having better keeping qualities. It is added in the proportion of one or two ounces of the liquid or half as much of the powder to the quart of 1 to 5 hypo, or even more if used for gaslight papers in warm weather, when great hardening is desired. In the writer's hands, the liquid bisulphite has proved far superior to any other substance and has quite displaced all formulas calling for alum. Precipitation of sulphur is not often obtained with this chemical and the bath keeps clear until exhausted.

Hypo too Strong. — Many troubles are caused by not using enough water in which to dissolve the hypo. The proportion of 1 ounce of hypo to 4 ounces

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of water is the strongest which is safe, and 1 to 5 is much better.

Hypo too Warm. — If the hypo, in common with the other baths, is used much over 70°, the film will soften, frill, or even peel off. In hot weather it is best to wait for a cool evening or to use ice liberally, packing the fixing-tank in a pail with some lumps of ice. But it is better to use the solutions warm than it is to take a plate or film out of a warm developer and place it in an ice-cold hypo solution. Those who have electricity should use a fan in the darkroom. If the bottles and tanks are wrapped with flannel and set in trays of water, the blast from the fan will keep them reasonably cool. The cellar is the ideal place for a darkroom, because it is cool in summer and warm in winter. The writer's has never gone below 50° in zero weather or over 72° in the hottest spell in years. At the latter temperature the sodium bisulphite prevents frilling and staining even though the plates are not rinsed before fixing.

Troubles in Fixing Films. — In spite of the utmost care, films seem prone to cause troubles in fixing. We have already pointed out a good way to fix them, viz., in the strip, in a special long tray. If, however, an ordinary tray is used, it is well to cut up the roll into lengths to fit the tray, rounding off the corners with scissors to prevent scratching, and to keep the pieces well immersed by handling them over at frequent intervals. Unless this is done, portions will buckle up and remain out of the hypo. If there are traces of developer in the film or if fixing is done in a strong light, the parts thus exposed will often refuse to fix out entirely. Some workers prefer to attach the

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films to glass plates by means of rubber bands and to fix them in a regular fixing-box with grooves. This plan is particularly good with filmpacks.

Exhaustion of the Hypo. — When hypo is used in a tank it is necessary to avoid using it too long. A bath in good condition should clear all the milky look out of the film in ten minutes. If it takes longer than this, at summer temperatures, the bath should be thrown away.

Thorough Fixing. — After all the milkiness has disappeared the plate or film is only half fixed and must be left in for at least as long again. If this is not done, there remains in the film a compound of silver and hypo which will afterwards turn dark on exposure to light and ruin the negative. Proper fixing, as just directed, is even more important than thorough washing, for even if hypo should crystallize out on the negative it could be removed by washing again, but the stain just mentioned is practically impossible to get rid of. A great advantage of the tank is that light is excluded until fixing is complete, at least in the case of black "composition" and hard-rubber boxes, the latter being worth the increased cost because of their long life.

Insufficient Washing. — The habit of beginners to throw films or prints into the ordinary washbowl, turn on the water, and go away for an hour, is responsible for many defects. To wash well, films must be kept separated all the time. For this reason we advise handling film in the strip as directed earlier. Filmpacks may be washed in the rack in which they are developed by placing it in a large tub or can provided with small holes at the bottom and setting

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under the faucet. The flow should be regulated to keep the films always covered. Hypo, being heavier than water, sinks to the bottom and passes out of the drainage-holes. Twenty or thirty minutes in such a device is enough to eliminate the last traces of hypo.

Washing Plates. — The zinc washing-boxes which provide for a continuous flow of water are strongly recommended. Thirty or sixty minutes is enough if the flow is uninterrupted, but we have seen some boxes which had holes at the bottom run dry from accidental shutting off of the supply. The result was that the plates got partly dry and showed uneven density which ruined them completely. We therefore advise the styles which have the overflow at the top.

If a box is not obtainable, plates may be washed in trays by changing the water 12 times at intervals of 5 minutes.

Plates washed vertically in running water are invariably cleaner than if handled film up in trays.

Troubles in Drying. — If the following precautions are observed there should be no difficulties. The first is to remove all surplus water from both front and back of the film or plate. Wet a tuft of clean absorbent cotton and swab both front and back of the plate, at first under the faucet, then, with the cotton wrung out, in the air, until all tear-drops are removed. The second is to have them well separated. Drying-racks for plates are provided with too many grooves, but that is no reason why they should all be used. Six plates four grooves apart are enough for one rack. Set the rack in a current of air in a dust-free place, because rapid, even drying in a moderate temperature is essential. In summer, be particularly careful to

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secure rapid drying, using the electric fan whenever possible. If germs and moulds settle out of the air on the wet gelatine in hot weather they will grow in it and cause all sorts of spots and defects. Some sorts liquefy the gelatine and form round transparent holes. Insects eat the coating greedily. Never let sunlight fall on the drying plates. In winter avoid temperatures over 75°, such as may easily be found near a steam radiator.

Spots on Negatives. — After the negatives are dried they often show spots which appear light in the film and print black on paper. The remedy is "spotting." This term means the blocking out of the defect with opaque red water-color applied with a very fine brush. The operation is an easy one, but requires some knack. Select a small red sable brush which comes to a very fine point when wetted. Moisten it and work up the color with the tip. When the brush is so nearly dry that it will make only a few small spots when the end is touched to paper it is in condition to begin. Support the negative where you can see through it against a piece of strongly-lighted white paper and apply the tip of the brush to the center of the spot. Small pinholes may be filled with one application, but larger ones should be treated with a series of dots, carefully placed side by side. If the first lot do not completely stop up the hole, let them dry and go over them again. After you become expert you can use black color and match the tint so well that subsequent spotting of the print will not be necessary.

What a Good Negative Looks Like. — A well-timed negative will have no clear glass except in the tiny

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little flecks of the very deepest shadows. The range of gradation runs up to a moderate density in the highest lights, but these last should not be so thick that one cannot read very small heavy-faced type through them when the negative is laid film-down on the printed page.

Underexposed Negatives. — An undertimed plate lacks detail in the shadows, that is, it has clear glass. If overdeveloped, the highlights are too dense and refuse to print until the shadows have become lost in blackness. If properly developed, the contrast is not so great. If underdeveloped, the whole plate may be thin, but can be distinguished from a well-timed, underdeveloped plate by the fact that the latter has detail in the shadows, though too thin to print well.

Overexposed Negatives. — When the light action has been excessive, there occurs a phenomenon known as partial reversal of the highlights. In moderation, this action is beneficial, for you can readily see, if you will take the trouble to develop for the same length of time two exposures, one correct and the other about one-eighth normal, that the density of the highlights of the latter is relatively and absolutely greater. That is why underexposure gives such harsh results: the film develops to the greatest density of which the emulsion is capable. But as the exposure is increased, the continued action of light on the film reverses the effect on the silver salts until at a certain point the highlights of the object are represented by no deposit at all on development. In overexposure of moderate degree, however, the effect is simply to bring about a thinning of the highlights from partial reversal, so that they print out flat and gray. At the

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same time, the light has produced too much shadow-detail and the whole plate lacks contrast between the tones. If, as is the tendency in development by inspection, the beginner is alarmed by the rapid appearance and subsequent burying of the image and snatches it out of the developer, he will get a thin, flat negative. The proper treatment is to wash the plate under the faucet and finish development in a solution of double the normal strength, with plenty of potassium bromide; but this course must be adopted early to have much effect. Development must be continued for the same length of time as is required for a normal exposure, or even longer, in order to exaggerate the density as much as possible and thus supply the missing snap. Known overexposure should be treated from the beginning in a strong developer with plenty of bromide. The Watkins system of Thermo Development automatically provides for the right length of time in the solutions and ensures good average results. A thoroughly developed overexposure may often be converted into a passable negative by reduction and intensification. The points which determine that a plate is overtimed are the excess of shadow-detail and the thinning of the lights by partial reversal. Remember that this thinning can and does take place in accurate exposure, though to a much smaller degree. In fact the object of timing fully is to secure a proper thinning of the lights with an accurate rendering of the shadows, so that the resulting negative will print out all the tones about as they appear to the eye.

Intensification and Reduction. — Much may be done to convert bad negatives into passable "printers"

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by modification with chemicals which build up or cut down the density of the image. The best time to do this is immediately after fixing and washing, because if the film has once dried and hardened it is very difficult to get first-class results. Celluloid films, whether flat or roll, are extremely hard to handle; in fact, we have never been able to get good results with them in any method of after-treatment. It is possible to secure passable results if they are well softened in warm water, but even then they are prone to repel the solution in spots.

Negatives Suitable for Intensification. — Intensification cannot supply shadow-detail which is not in the negative, but it does greatly strengthen the deposits; therefore negatives which have had good exposure but are too thin to print well even on contrasty gaslight papers are best to intensify. Overexposed negatives generally require the removal of some of the shadow-detail by means of ferricyanide and hypo before they are intensified. As a rule, intensification gives the same effect as if development had been continued farther, but does not increase the contrasts so much as prolonged development does.

The Best Intensifier. — Mercuric iodide is the simplest intensifier to use and the least likely to cause streaks and spots. It is marketed in tablets, among which we may mention the Burroughs Wellcome "Tabloids" and the Burke and James "Ingento" Intensine Tablets. Both of these are made up with sulphite of soda. A simple solution which will keep for years may be prepared as follows. Dissolve 200 grains of mercuric chloride (corrosive sublimate, a deadly poison) in 16 ounces of warm water. Dissolve

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1 ounce of potassium iodide in 10 ounces of water and add this solution a little at a time to the mercury. A red solid, which is mercuric iodide, will separate out. Continue adding the potassium iodide until the red solid is completely dissolved and you will have a perfect intensifier which will keep good indefinitely and may be used over and over until its intensifying effect is exhausted.

Perhaps the greatest advantage of this particular intensifier is that hypo does not interfere with its action, so that it may be used after only a short rinse as soon as the fixed plate is found to need strengthening. If the plate has been washed and dried it will be necessary to soak it in water at about 75° to soften the gelatine and ensure even action. Intensification begins in about a minute and proceeds rapidly. For many negatives an immersion of about two or three minutes is ample; but the action may be allowed to continue until it stops, if great strengthening is required. As soon as sufficient density is attained, which may be told by looking through the plate, the negative should be well washed under the faucet and then blackened by about five minutes' treatment with any used developer. Twenty minutes' washing in running water completes the process. This intensifier is freer from troubles than any other if the directions are observed. Slower action can be obtained by adding more water. Small parts may be intensified by applying the solution with a quill-set camel's hair brush.

Reduction with Persulphate. — Overdevelopment is a common fault of the beginner, so what is needed is a reducer which will cut down the excessive density

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of the highlights without affecting the shadow-detail. The "soot and whitewash" type of negative can be improved by using ammonium persulphate. This salt cannot be kept in solution and spoils even in the solid state, so if a specimen refuses to reduce it must be thrown away and a fresh bottle purchased. Make up a bath containing 15 grains of persulphate to the ounce of water, using enough to cover the plate well. Give the negative an extra hour's washing in running water before mixing the reducer, because if the slightest trace of hypo is present the plate will be stained. Immerse the wet negative in the bath and rock it constantly. After one or two minutes the bath will begin to turn milky, showing that reduction has begun. If only a slight action is desired, remove the negative as soon as this occurs to a tray containing sodium sulphite solution, 1 ounce of the anhydrous sulphite to 10 ounces of water. If this is not done, the reduction will continue. After ten minutes' soaking in the sulphite, give the plate a thorough washing in running water. Greater degrees of reduction may be secured by longer treatment in the persulphate, but the plate should be taken out a little time before the reduction seems sufficient, because the action continues for a while in the sulphite bath.

The negative, after reduction with persulphate, should have the same printing-quality as if development had been stopped earlier.

Reducing Overexposed Negatives. — Ferricyanide with hypo acts in just the opposite way from ammonium persulphate, eating away the shadow-details long before it affects the highlights. It should therefore be chosen for overexposed negatives and applied

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just long enough to remove the right amount of detail. Many photographers prefer to employ it as soon as the plate is out of the hypo, if they are using a plain (not acid) bath, applying the ferricyanide with a tuft of absorbent cotton. When used thus it affects the highlights more than if the two salts are mixed and poured on a negative which has been previously washed and dried. The easiest way is to put some crystals of potassium ferricyanide (red prussiate of potash) into an amber-glass bottle and add water from time to time. Mix a hypo about 1 to 6 and add enough of the ferricyanide solution to turn it a straw color. Immerse the plate and rock it constantly. The action is rapid, so it is necessary to examine the plate frequently, taking care to rinse it well under the full stream from the faucet in order to avoid stains, before holding it up to the light for inspection. As soon as enough detail has been removed from the shadows, wash in running water for at least twenty minutes. If the negative is lacking in vigor it may be intensified with mercuric iodide.

Acid Permanganate. — Potassium permanganate acidified with sulphuric acid acts somewhat like persulphate if applied to the dry negative, whereas it reduces all tones evenly if the negative has been previously wetted. The brown stain which it gives is cleared off by a ten per cent solution of sodium bisulphite. It is more certain in its action than persulphate:

A.	Potassium permanganate	7 grains
	Distilled water	35 ounces
	Sulphuric acid, C. P., (1.84 S. G.)	30 minims
B.	Sodium bisulphite (liquid)	1 ounce
	Water	10 ounces.

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Poor Chemicals. — The beginner is often led by consideration of price to purchase other than the expensive chemically pure ingredients for his work; but this is the falsest kind of economy. Good films and paper may easily be ruined by impurities in the chemicals. Cheap developers in tubes or powders are often impure or spoilt. If you do not mix your own solutions, do not be led into buying any but the best prepared chemicals. Remember that too low a price means inferiority.

Water. — The most important chemical is water, and volumes might be written on this topic alone. In general, however, we may say that water that is fit to drink is all right for photography. Troubles can be warded off from the start by boiling and filtering. Boiling for about twenty minutes drives off dissolved air and other gases and also gets rid of some injurious salts. Lime and magnesia, however, remain in solution and may cause trouble, so if the water is very hard it is better to use clean rain water if it is available. Filtering may most easily be performed by placing a tuft of clean absorbent cotton in a glass or hard-rubber funnel and, after wetting it, spreading it out so that it comes well up the sides and lies snugly. Sometimes regular filter paper is used, but cotton answers most photographic purposes equally well and is much quicker in action. The boiled water should be filtered as rapidly as possible while still hot and allowed to cool in a covered jar so that it will not absorb much air.

Stale Solutions. — All developing-substances, such as pyro, metol, amidol, etc., have an affinity for oxygen; that is, they unite with this gas when it is

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dissolved in the water. The measure of the oxidation is, roughly, the color of the solution. When freshly made, developers have no color or but a faint tinge of some tint, depending on the particular substance used, but if they are allowed to stand exposed to the air, as in an uncorked bottle or in a graduate, they rapidly combine with oxygen, turn brown and muddy, and soon become useless. Sometimes the solid developer itself spoils in contact with the air. This is notably the case with amidol, which when fresh is almost white and when stale, as shown by its acquiring a gray color, loses a great deal of its energy, becomes incapable of giving a good color to the deposited silver, and is liable to stain the gelatine of papers or plates. Therefore the first rule for keeping all photographic chemicals is to store them in bottles filled to the neck and tightly corked to exclude air. Good, sound corks may be dropped into melted paraffin wax to waterproof them and will then be found to keep air out more effectively than before treatment. It is a good plan to dip the corked bottle over the lip of the neck into the same wax if the solution is to be kept for some time. One thing is sure, half the troubles in getting good results come from deteriorated chemicals. Suppose you make up 16 ounces of M.-Q. developer. If this quantity is put into a pint bottle it will keep fairly well until a few ounces have been used. Then the admitted air begins to act on the metol and the hydrochinon; the color gradually darkens; the prints show a tendency to greenish or brownish blacks, and the chances are that the last few ounces of the solution will be so brown that they must be thrown away. Now, if this quantity had been put

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up in four-ounce bottles, with the corks sealed with melted paraffin, the last bottle would have been as good as the first.

Single-solution developers do not keep as well as those made up in two or three solutions. Sodium sulphite is the preservative. Its function is to combine with oxygen instead of letting the oxygen attack the developing substances. If sodium carbonate is added to the same solution, the oxidation of the sulphite takes place more rapidly, so that it is soon used up and can no longer protect the developer. The more concentrated the solution, the less rapidly it oxidizes. The ideal way is to make up at one time developer for the day's work only. The convenient way is to make up small quantities of concentrated stock solutions, remembering that sulphite in solution is not very reliable after one week. The same substance in powder (sodium sulphite, anhydrous) will keep indefinitely without change. Our advice is never, under any circumstances, to use any but chemically pure anhydrous sulphite and "dry granular" or "anhydrous" carbonate.

Hypo in the Developer. — Although it is true that some developers, such as metol, can be used with hypo, the safest rule for the beginner is to keep the hypo away from everything else. The fingers should never touch even the tray or tank containing hypo without being washed at once and wiped dry on a special towel which is kept for that purpose only, before touching developer, plates, or papers. Metol-hydrochinon, the most popular of all developers, is particularly sensitive to hypo, and whenever the least trace of it is conveyed to the developing-tray is sure

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to be contaminated, with the result that there soon appear stains, streaks, blotches, uneven development, and a host of other troubles.

Not only do unwiped fingers convey hypo, but also the air of the darkroom. If hypo is allowed to drip anywhere and not at once wiped up with a damp cloth or sponge, it dries and soon gets into the dust as a fine powder. Then it settles everywhere, spoiling films, papers, and solutions. Other dry chemicals, such as pyro, are likely to do the same. Pyrol, or pyro in large crystals, is therefore to be preferred if it must be weighed. With this developer, the usual plan is to dissolve an entire ounce at once to form a stock solution, thus avoiding the troublesome weighing.

Other Chemical Contaminations. — Mercury in any form is one of the hardest chemicals to get rid of and at the same time one of the first to get out of its proper place and ruin films and papers. The tray used for intensification with mercury should never be used for anything else. The most scrupulous cleanliness must be observed, and the hands should be thoroughly scrubbed with soap, hot water, and a nailbrush before doing any other work. Other substances may get out of place and cause troubles. The only way to avoid them is to keep everything spotlessly clean. Dirty trays, graduates, bottles, and other utensils can be rapidly cleaned with acid permanganate or with potassium bichromate and sulphuric acid. The scale which forms in bottles holding alkaline developers may be removed by shaking with hot soapsuds and shot. It is due to the carbonate attacking the glass. Trouble from it may be pre-

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vented by filtering the developer into the tray just before use. In fact, this precaution should never be omitted.

Method and Cleanliness. — Most of the troubles we have just been considering are due to faulty methods of working and lack of cleanliness. They can all be avoided by adopting a definite scheme of work. Always have the same trays in the same places. Always rinse the films or plates before fixing. Always rinse and wipe the fingers after touching any solution. Always rinse the fixed plates before holding them up for examination. These are only a few of the precautions which if consistently practiced will become so much a matter of habit that you will instinctively do the right thing every time. Unless you do work methodically it will be impossible for you to trace the cause of defects and to take measures to prevent the same mistakes in the future. System and perfect cleanliness will bring their own rewards in the shape of perfect negatives and prints.

Overworked Baths. — Photographic chemicals are so cheap that it is folly to attempt to overwork them. With papers particularly, strong, fresh developer is essential. The way to save money is to buy the chemicals and compound your own developers and other solutions, throwing them away and using fresh as soon as the quality of the result suffers in any way. Hypo is so cheap that there is no excuse at all to retain a bath after it has begun to work slowly. Stain, due to oxidized developer and dissolved silver, is the sure reward of using an exhausted hypo. Incomplete fixation in such a bath will lead to ruined films. The chemicals cost almost nothing as compared to films

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and papers, but if overworked they can easily spoil materials representing many times the value of fresh solutions.

Mixing Solutions. — The first thing to consider is weights and measures. The metric system is undoubtedly the best, but it gains ground very slowly in this country. A curious mixture of avoirdupois and apothecaries' weights is used in photography. The usual sets sold with scales are:

1, 2, and 5 grains, in aluminum

½ scruple,	equal to	10	grains	equivalent	to	about	0.66	grams
1 "	" "	20	"	"	"	"	1.33	"
½ dram	" "	30	"	"	"	"	2.00	"
1 "	" "	60	"	"	"	"	4.00	"
2 drams	" "	120	"	"	"	"	8.00	"
3 "	" "	180	"	"	"	"	12.00	"
½ ounce Av.,	" "	220	"	"	"	"	14.15	"
1 " "	" "	440	"	"	"	"	28.30	"
2 ounces	" "	880	"	"	"	"	57.6	"

The most useful equivalents are: 15 grains = 1 gram.
30 cc. = 1 fluid ounce Apoth.

Gr. stands for grains; gm. for grams; cc. or ccm. for cubic centimeters. The weight of 1 cc. of distilled water at 4° Centigrade is 1 gram.

Ten Per Cent Solutions. — By the metric system it is easy to mix a 10 per cent solution. Suppose you have bought an ounce bottle of potassium bromide and wish to make it all up at once. Its metric weight is 28.3 gm. Dissolve the bromide in about 200 cc. of water and make up the bulk to 283 cc. Then each cubic centimeter will contain $\frac{1}{10}$ gm. Since 283 cc. are roughly equivalent to $9\frac{1}{3}$ ounces, this latter value should be taken in the apothecaries' system. Simply to dissolve one ounce of bromide in 10 ounces of water produces a weaker solution than prescribed.

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Saturated Solutions. — The directions for some makes of developing-papers call for a saturated solution of potassium bromide. This means that the water will have dissolved all the bromide which it is capable of holding in solution and that there will remain some of the undissolved salt at the bottom of the bottle. For all practical purposes, the temperature of the ordinary room, say 65° F., is understood. In cold weather, the solution will contain less than in summer.

Mixing Metol-Hydrochinon. — Each developer has to be mixed in accordance with a certain plan, this being usually indicated by the order in which the ingredients are printed. As an example we may take the ever-popular metol-hydro. Take a little less than the prescribed quantity of water, preferably lukewarm, but not hot, and thoroughly dissolve the metol. Next dissolve the hydrochinon, making sure that every crystal has completely disappeared before adding the sulphite. Stir the solution well and add the anhydrous sulphite in a fine stream, pouring it from a piece of paper creased in the middle. If the stirring is vigorous, the sulphite dissolves rapidly without caking. Then add the anhydrous carbonate in the same manner and finally the bromide, either solid or in solution. The resulting developer should be perfectly clear and water-white; but it is safest to filter it before use. Most developers are mixed in this manner.

Mixing Amidol. — Amidol, which works without carbonate, has to be prepared in a different way. First completely dissolve the sulphite and then the amidol. Use at once, adding just enough bromide

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solution to keep the sensitive film free from fog. The best formulas are those of Wellington and Ward.

For gaslight paper

Water to make	10 ounces
Sodium sulphite, anhydrous	250 grains
Amidol	50 grains
Potassium bromide	2 grains

For bromide paper

Water to make	20 ounces
Sodium sulphite, anhydrous	325 grains
Amidol	50 grains
Potassium bromide	10 grains

Amidol can be used for plates or films. A good formula is

Water to make	10 ounces
Sodium sulphite, anhydrous	½ to 1 ounce
Amidol	20 to 40 grains
Potassium bromide	2 grains

This formula can be adjusted to give more density by using the larger quantity of amidol, or more detail by using the larger quantity of sulphite. Amidol is a very rapid developer, so in using it one must take care to flood the entire plate at once to avoid uneven density.

When amidol is used for paper it is extremely important to get just the right amount of bromide for the particular paper used. Enough must be used to clear the whites, yet an excess, which causes greenish or brownish blacks, must be carefully avoided. In general, increasing the sulphite and decreasing the water will be found to produce bluer blacks. A weaker solution gives a pure black which is almost impossible to match with any other developing agent.

Never mix amidol solutions in greater quantities

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than required for immediate use on the same day. Adjust the proportions to give the color you like best and you will find it an almost ideal developer.

Troubles with Metol-Hydro. — Although M.-Q. is the most popular of all developers, it is too sensitive to bromide, which readily causes the print to deteriorate. It also stains the paper if used weak, a condition otherwise favorable to better detail in the prints. The usual formulas can be greatly improved by taking equal weights of metol and of hydrochinon. Never use it for paper after it has much discoloration.

Mixing Glycin. — Glycin is not soluble in water, therefore it must be added last, as it is freely soluble in alkaline solutions. Metol counteracts its slowness and gives a rapid developer which combines all the advantages of both agents. It yields bright, sparkling negatives and a full range of printable detail in all the tones from dark shadows to the densest highlights. Our favorite formula is:

Water	20 ounces
Metol	60 grains
Sodium sulphite, anhydrous	½ ounce
Sodium carbonate, anhydrous	1 ounce
Glycin	120 grains

Dilute with 1 to 2 parts of water for plates. Wash the negatives well under the faucet before fixing to prevent yellow stain.

Chemical Fog. — When a developer is too much diluted, it may cause a gray fog, because the proportion of sulphite falls too low. The smallest amount of sulphite which should be used is 10 grains of the anhydrous salt to each fluidounce of ready developer. Hence, if at any time fog occurs, make up a 12½ per

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cent solution (60 grains in each ounce) of sulphite and add enough of it to the working developer, in place of plain water, to secure the presence of 10 grains or more in each ounce. One ounce of the 12½ per cent solution is sufficient for 6 ounces of developer. The extra sulphite is particularly needed in tank development to prevent fog, stain, or veiling.

By using sulphite in the correct proportions, one can dispense with the use of potassium bromide as a restrainer and at the same time retain the full amount of shadow-detail, with clearness of the shadows.

Strength of the Sodas. — The anhydrous sodium sulphite is uniform in strength, no matter what its source. It keeps so well that even in a partly filled bottle or tin can it loses only 1 to 5 per cent of its sulphite in a year. As most samples average 95 per cent purity when fresh, it can be confidently looked upon as at least 90 per cent pure after long keeping.

Anhydrous carbonate is more than twice as strong as the crystals when perfectly fresh, but it almost immediately absorbs from the air one molecule of water, and its strength is then just double that of crystals. The most permanent form of carbonate is the dry granular, pure photographic, or monohydrated (all these names are used by different firms) which is at all times uniform in strength at double that of crystals.

Carbonates which are advertised as so much stronger than other brands of anhydrous carbonates that they must be used in smaller amounts are usually not pure carbonate but a mixture of this salt with potassium carbonate, as can readily be told by inspection through a magnifying glass, when it will be seen that they contain two different substances.

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Troubles Due to Stale Solutions. — The amateur is strongly advised to mix his solutions in small quantities because of the fact that stale developers act less vigorously and yield plates and prints lacking in brilliancy or even entirely spoiled by stains. Weak, much-used hypo is another source of trouble. Since the permanence of the work depends on the complete removal of soluble silver salts from the film, it is essential to use a bath containing a large excess of hypo. Exhaustion can readily be detected by the slowness with which the fixer works and the fact that patches of yellow silver bromide can be seen on the glass side even when the plate has been long immersed. In the case of films, complete covering with the hypo is essential, because if patches remain unfixed and white light is allowed to fall on them they sometimes refuse entirely to fix out and a bad spot is the result. Even if all the yellow seems to have disappeared, unless there is sufficient excess of hypo present the colorless compound first formed is not removed and the negatives become stained when exposed to light in printing. The remedy is a fresh bath. Never strengthen an old bath with more hypo, for the dissolved silver is likely to stain the negatives. If economy is an object, it is better to pour spent fixing-baths into a large stoneware crock and recover the silver for the refiner. Methods may be found in the more elaborate textbooks and manuals.

Cleanliness, and again Cleanliness. — The defects we have been speaking of are nothing but variations on the old theme of cleanliness. The formation of regular methods of working, combined with care to keep everything scrupulously fresh and uncontami-

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nated, will prevent most of these defects. We see the effect of chemical dirt more readily when we come to the printing processes, which we shall now take up.

Handling Printing-out and Self-toning Papers. — The fingers, even when they seem perfectly clean, are seldom free from substances which have an effect upon sensitive materials of all kinds, but they act most quickly when applied to the film side of papers. The natural moisture of the hand, containing, as it does, a certain amount of oily matter, instantly attacks the film. When the defect takes the form of a finger-print it is easily recognized, but this is not always the case, and the beginner is in despair because his prints come out dirty, unevenly toned, or full of reddish specks, not knowing that he has unwittingly touched the film side. Bad as the normal fingers are, they are as nothing compared to the same instruments when contaminated with hypo or other chemicals, the slightest traces of which spoil what would otherwise be perfect prints. In handling all kinds of papers, then, it is necessary to wash the hands carefully and dry them on a clean towel: but after this precaution has been taken it is still essential not to touch the sensitive side, but to handle the paper by the edges only.

Self-toning paper has largely displaced the older P. O. P. because of the simplicity of manipulation. It is probably the best paper for the beginner if reasonable care is taken in its use. The directions for the particular brand in use should be strictly followed. The depth to print is readily learned by making several prints of different depths from the same negative. The plain hypo used for toning and

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fixing must be carefully made up to exact weights and measures. Most makers advise the addition of a pinch of baking soda, because an alkaline bath tones more evenly and the color is due to the gold alone instead of sulphur separated from the hypo, which is the case if the bath is acid. The temperature should be kept between 60° and 70° by the use of warm water or ice as the case may be. Even the wash-water must be brought within the same limits if you do not desire blisters. This is easy to accomplish if the plan of washing in trays be followed.

Other Precautions. — Prints should be trimmed before toning. Immerse them one by one so that the surface is evenly covered, and, when they are all in, place them in pairs, back to back, and keep them in constant motion. If they are allowed to come in contact for more than a few seconds they are sure to show uneven toning. The same method should be adopted while the prints are in the hypo. Do not begin to fix until the prints are all toned, because if you should transfer a trace of hypo to the toner the prints would be spoiled. Washing is best carried out in a similar manner, using two large trays full of water. Put all the prints into one tray, pour off the water, fill again, and then put them one by one into the other tray. Then wash out the first tray, fill it with fresh water, and fill it up with prints as before. Washing should take an hour by the clock. This method may seem troublesome, but our experience is that it is the surest way to eliminate hypo and thus avoid fading of the prints.

Even Toning of P. O. P. — If permanent, uniform tones are required, it is best to mix a bath so that

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there will be just enough gold to tone the prints completely. Allow $\frac{1}{10}$ grain of gold chloride (solid) for each 4×5 or postcard print and mix as many ounces of bath as will contain this amount for each print to be toned. The prints are left in this solution until toning ceases, and the spent bath is then rejected.

The Combined Bath. — Most beginners are misled by the apparent simplicity of the process into buying combined toning and fixing powders or solutions. We strongly advise against this practice, as the prints are seldom permanent. Simplicity is best attained by the use of self-toning papers, not by resort to toning and fixing in one bath.

Development Papers. — For one camera owner who uses printing-out paper there are hundreds who use nothing but the so-called gaslight papers. The advantages of the latter for evening work — which is all that most amateurs have time for — are legion. The well-advertised brands may be relied upon, but there are certain qualities about each make which cause it to receive the preference according to the taste of the user. Most beginners like what they call a " clear " print, meaning one in which the shadows are very black and the light parts almost pure white. When they become more advanced they abominate such " soot and whitewash " effects. Now, the great advantage of gaslight papers is that they are made in different grades of contrast, so that the same negative may be made to yield a hard, brilliant print or a soft, gray one. This allows one to increase or to decrease the contrasts shown in the negative to suit the individual's ideas. The varieties of paper are named, for example, Contrast, Normal, and Soft; or Hard X,

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Hard, and Soft. Velox is made in only two grades, Regular and Special. The Contrast or Regular papers are useful when for any reason the difference between the strengths of the silver deposits in the negatives are not great enough — say in the under-exposed and underdeveloped negatives. A well-timed and not overdeveloped negative should print about as contrasty as it looks, hence the papers for it are the Normal or the Special. Finally, we may have a negative which gives a harsh print because the high-lights are so dense that they are not impressed on the print before the shadows are overdone, in which case we must rely on Soft or Special grades to soften the violence of the contrasts. It is thus evident that by a proper choice of paper we can get almost any effect we desire. We have, too, some very slow papers intended for studio portraiture, chief among which we may mention Artura Iris and Professional Cyko; these being fine for normal negatives if one has a strong light for printing.

Negatives for Gaslight Papers. — The amount of contrast which gives just the right effect on P. O. P. is rather excessive for most brands of gaslight papers, because they all tend to increase the contrasts of the negative. The ideal negative is very fully timed and developed only so far as to give highlights which are not very opaque, in fact, rather a thin negative. As such a film or plate is the most suitable for bromide enlarging, we advise novices to make that type of negative rather than one which is developed farther and hence more contrasty.

The Secrets of Success. — Since paper stains more easily than films, it is quite important to develop

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rather quickly. M.-Q. developer, which is recommended by most makers, is particularly likely to stain the prints if used diluted, warm, or contaminated with hypo or other foreign chemicals. Potassium bromide in various quantities is needed for almost all papers in order to keep the whites clear; but M.-Q. requires more than do the other agents we have named. Even with these, however, care must be taken to use unoxidized solution with the minimum amount of bromide if clean prints with good blacks are desired. Given a good, active developer, success depends on correct exposure, that is, on such an exposure that development is completed within 30 seconds to 2 minutes, depending on the paper — and allowing the print to remain until development ceases. If the print is then too hard the only remedy is to use a softer-working brand. If a print is overexposed it will develop too rapidly, come out too dark, and be an unpleasant greenish or brownish black. The print, after development, must be quickly washed in clean water or weak acid and fixed in a fresh, strong acid fixing-bath.

Use Test-Strips. — The least expensive way to work is to cut a sheet of paper into strips and use them until precisely the right time to print is found for the negative.

Underexposure and Forcing. — Almost invariably the beginner who happens to undertime a print tries to bring out more detail in the halftones by letting it lie in the developer. With M.-Q. particularly, but also with other agents, this results in yellow whites. The exposure must be increased so that the print develops steadily to the right depth and then pauses, when it must be promptly rinsed and fixed.

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Overexposure and Underdevelopment. — When the print has been overtimed and the image flashes up and becomes too black it is little use to try to save the sheet of paper. Cut down the exposure or use the next more contrasty grade. If the overtimed print is snatched out and fixed, the color will be unsatisfactory.

Technique of Printing. — The beginner should arrange some means of securing a uniform distance from the light. For example, using a 4 × 5 frame and a Welsbach mantle, mark off a distance of, say, 7 inches from the light and always place the frame on that mark. Then, if the mantle is discarded as soon as it begins to show signs of dimming, the condition can be duplicated at any time. The frame should always be about as far from the light as the measurement of the diagonal of the negative. Any other source of light can of course be used. A convenient arrangement is to have the light at one end of the workbench and separated from the rest of the space by a large sheet of cardboard or post-office paper. The unexposed paper should be kept in the shadow of the screen to prevent it from being fogged — a prolific source of trouble. Printing should be timed by the clock to ensure uniformity. Systematic workers record on their negative-envelopes the number of seconds required at a given distance with the standard light and a certain grade of paper.

Arrangement of Trays. — A definite order should be adopted in arranging the apparatus. For example, at the left place a tray the size of the paper used, filled to a depth of half an inch with fresh developer. Next put a larger tray containing clean water, or,

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better, water acidified with acetic acid, say 1 ounce of No. 8 (25 per cent) acetic acid to a quart of water. On the right have a tray with plenty of fresh acid hypo. Either a wooden paddle or a glass funnel, stem up, should be used to immerse the prints in the fixer so that the hands need never touch the hypo.

Developing. — Take the exposed paper from the frame in the shadow of the screen and slide it face up into the developer. Turn it over a few times and press it down under the surface. As soon as the proper depth is reached, remove the print and let it drip for a few seconds. Then pass it into the weak acid and keep it in motion, turning it over and over for a few seconds to wash off all traces of developer. Prints may be allowed to accumulate, in safe orange light, during ten minutes, when they should be removed one by one to the acid hypo, keeping each in motion for a few seconds as before. If plain water is used for rinsing, no time should be lost in getting the prints into the fixer and moving them about for at least five seconds.

Fixing. — Single-weight papers should be fixed at least ten minutes; double-weight papers twice as long. Too long fixing is, however, almost as bad as insufficient fixing. After a batch of prints has fixed the proper time, it is best to remove them to clean water until all are ready for washing. A good plan is to place all prints face up for ten minutes, then turn them all face down until another ten minutes has elapsed, meanwhile putting the new prints face up. After the second ten minutes the first lot should be taken out and the second lot turned face down.

A deep 8 × 10 tray is about the smallest which is

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convenient for fixing small prints, because it is necessary to keep the prints well separated so that they cannot mat together and fail to fix where in contact with others. This prevents stain, for it gives the acid of the bath a chance to neutralize any traces of alkaline developer which may have remained in the paper from insufficient rinsing. Each time a new print is put into the fixer the others should be moved about with the paddle or the funnel.

Never neglect to wash the fingers well and wipe them dry before going back from the fixer to the end of the bench where development is done. Remember that developer containing hypo is almost sure to stain the paper.

Friction or Abrasion Marks. — The smoother velvety surfaces and the glossy kinds of D. O. P. are sometimes marked with streaks or blotches which look like lead-pencil marks. These can be prevented by the use of a few drops of 10 per cent potassium iodide solution in the developer. Add a little at a time until an unexposed piece remains perfectly clean as long as it takes to complete normal development. Iodide produces softer prints and also changes the color to some extent. If more contrast is required, it may be had by adding a few drops of a saturated solution of common salt and the same quantity of a saturated solution of hypo. This recommendation seems inconsistent with what we have said above, but the iodide prevents staining. The prints come out of such a developer with a decided yellow color, but this disappears when fixing is complete.

Washing Prints. — Prints should be washed promptly as soon as all are fixed. If they are allowed

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to lie in water overnight they will soften and stain, particularly if there is iron from the pipes in the water. If a special washing-device capable of keeping the prints separated during the whole time the water is running is not available, it is best to wash the prints in trays as described previously. Thorough elimination of hypo is the foundation of permanence.

Drying Prints. — Constant users of gaslight papers find that cheesecloth-covered stretchers are most convenient for drying their prints. The prints are piled face up on a sheet of glass and drained. Each is carefully swabbed with a tuft of wet absorbent cotton to remove dirt deposited from the water and laid face down on the cheesecloth. Curling of the dried print may be prevented by methods described in the manuals furnished by the papermakers, or the prints when dry may be straightened by the use of "photoflat" or some similar preparation. Usually it is sufficient to place them face down on a smooth surface and draw them gently under a blunt-edged ruler, working from the middle to each corner.

Other Pointers. Control of Color. — Most papers are capable of giving a blue-black or a pure black print, though some are designed for warm-black tones only. The amateur papers pure and simple may be regulated in the following manner. Make up the developer without bromide and test it with a strip of unexposed paper. If the paper turns dark in the part which is wet, bromide must be added. Use it a drop at a time until on further tests the slip remains undarkened for about 15 seconds. This amount should keep the whites clear and give a fine blue-black

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color. For a pure black, add enough bromide to keep the slip unfogged for about 30 seconds. It is, of course, necessary to expose the prints so that they will develop completely and stop within the times named. Browner or greener tones are obtained by using more bromide.

Weak developers, in most cases, give less of the bluish black.

Oxidized solutions cause the color of the print to deteriorate, so the developer should be thrown away and fresh taken at intervals when a large batch is being put through. Another plan is to start with just enough to cover the print and to add an ounce of fresh after developing each half-dozen or so.

Preventing Stains. — The tray for paper developing should be cleaned after use with acid permanganate or potassium bichromate acidified with strong sulphuric acid, and afterwards washed to remove traces of these chemicals. The acid stop-bath is much more effective than plain water for rinsing. Fogged paper, which stains easily, may be saved by the use of a trace of potassium bichromate in the developer and increased exposure. Prints which are kept well under the surface of the different solutions are much less likely to stain than those which are lifted out for examination. Impure sodium sulphite, or stale developers in which the sulphite has become partly oxidized to sulphate, are common causes of staining. The remedy is to use only C. P. anhydrous sulphite and to make up only small quantities of developer at a time. Finally, allow at least a quart of acid hypo for each gross of 4 × 5 prints and throw away as soon as this number has been fixed in it.

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Conclusion. — In a book of this character it is obviously impossible to do more than indicate methods of working which must be modified by the individual to suit his own circumstances. We might go on indefinitely pointing out troubles and remedies, but that would take us out of the field covered by our title. Information on other processes will be found in more advanced books. In any case, do not rest content with what you have read here, but get and study all the other books for beginners which you can find. You will learn more from reading six different books than you are likely to absorb from reading one book six times. Whatever materials you use, get the makers' manuals and peruse all they have to say about manipulation of their products. In case of doubt, we invite you to write to the Editor of *American Photography*, explaining your difficulty. An answer will be sent by mail, and if the question is of sufficient interest it will be published under "Questions and Answers." And, last of all, subscribe to one or more photographic magazines. You will find them worth many times the outlay.

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